

# The NASA STEP Testbed: Building a Standards-based Engineering Information Technology Infrastructure

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Presentation for the  
NASA STEP for Aerospace Workshop  
January 27, 2000

# Benefits of Standards for Engineering IT

- Exchange of models among CAx tools from different vendors
- Exchange of models between CAx tools of different disciplines (electrical/mechanical/analysis/simulation)
- Standards-based format for NASA/contractor data sharing
  - Avoids requiring contractors to buy new CAx tools (cuts costs of contracts; avoids new learning curves)
  - Major OEM's are using STEP in this way
- Standard library and archive format, enabling:
  - Model re-use by later projects, independent of tools
  - Long-term storage of models, engineering knowledgebase



# The NASA STEP Testbed

## Product Master Model

- The concept of the **Product Master Model** is the synthesis (“intelligent union”) of all engineering discipline view-models of the product
- STEP and OMG standards provide the foundation for:
  - A **Product Master Model Schema** (STEP)
  - A **Product Master Model API** (OMG CORBA and PDME)
  - A **Tool Interface Backplane Specification** (STEP, OMG, and others)
- The **Product Master Model Schema** and **API** will support
  - Intelligent Product Data Management (IPDM)
  - Integrated Model-based Systems Engineering
  - A Global Product Model Knowledgebase
- A **Tool Interface Backplane Specification** to provide
  - Standardized interfaces between tools and model object services
  - Plug-and-play interactions between arbitrary combinations of COTS and in-house-developed software



# The NASA STEP Testbed

## Key Technology Targets

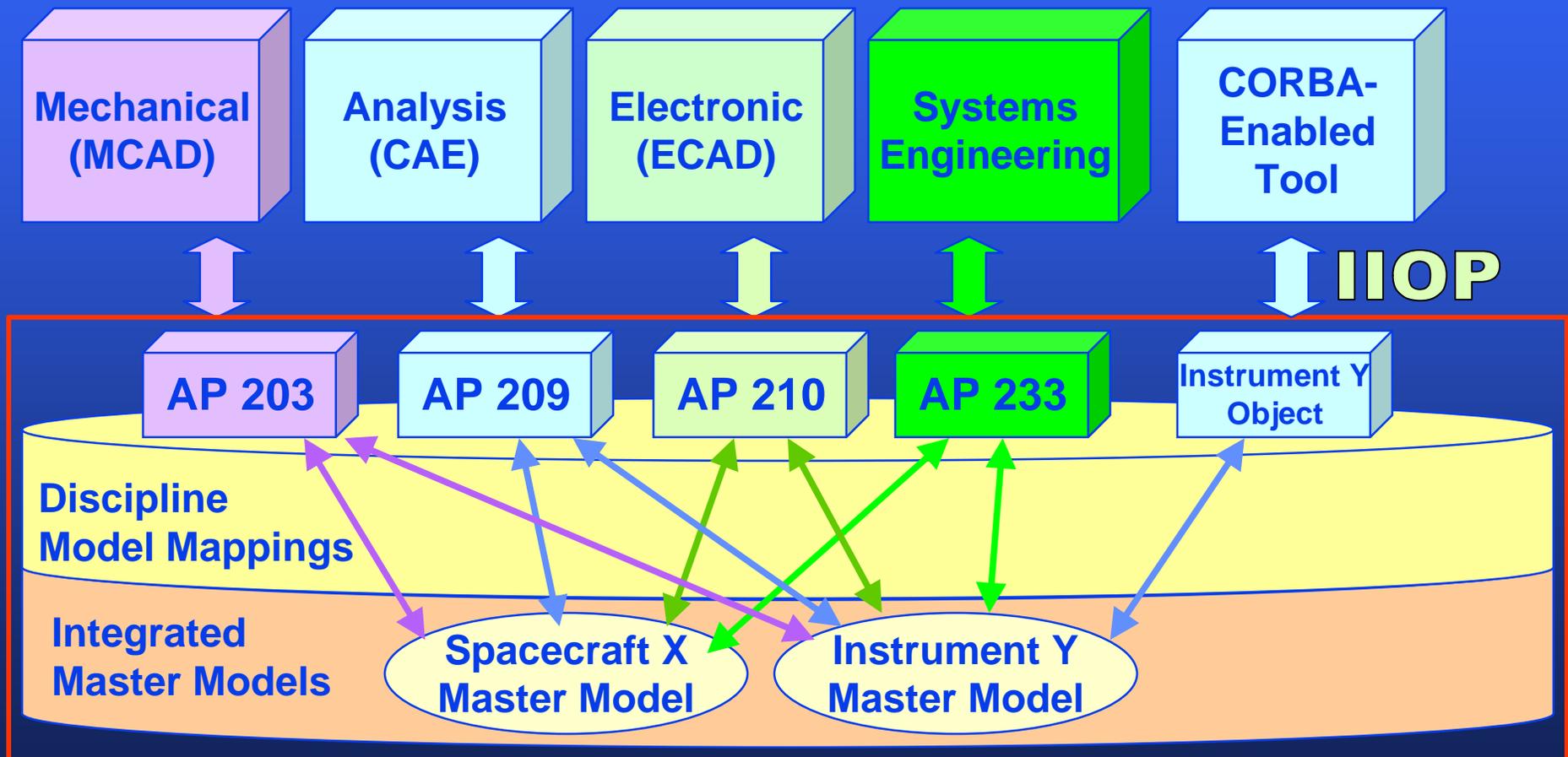
- **Intelligent-PDM** (*PDM = Product Data Management*)
  - Integrates heterogeneous, multi-disciplinary models into a Product Master Model based upon STEP and OMG standards
  - Provides interactive repository for CAx models (native and standard)
  - Provides net-accessible PDM services (Web or CORBA PDME\* objects)
  - Client application supporting standard interfaces, tool integration
- **Integrated Model-based Systems Engineering**
  - Builds upon IPDM and the Product Master Model
  - Incremental system model definition, validation, and verification
  - Systems Meta-Model containing discipline model interdependencies
  - Linkage of system model parameters to discipline-specific models
  - Immediate feedback on change impacts
  - Cross-disciplinary view of functions and requirements allocation
  - Client for all discipline engineers to communicate with systems view

\* "PDME" = PDM Enablers, an OMG standard object-oriented API for PDM systems.



# The NASA STEP Testbed Architecture

Integrating STEP and the OMG PDM Enablers



**NASA STEP Testbed**



# The Product Master Model Evolution: Incremental Population Over the Mission Life Cycle

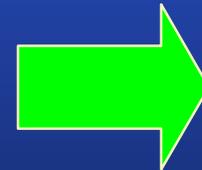
## Pre-Phase A

Integrated  
Mission Proposal



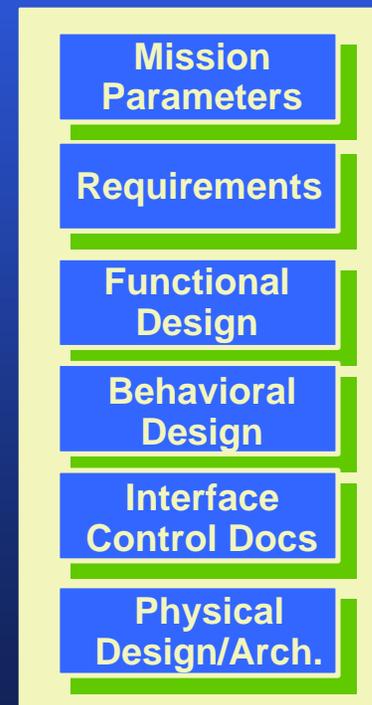
## Phase A/B

Prototyping  
and Analysis



## Phase C/D

Detailed Design,  
Build, and Test



# The NASA STEP Testbed

## Intelligent-PDM Pilot

### ● Objective:

- To provide a plug-and-play IPDM service for the management, integration, and synthesis of CAx models in a multi-disciplinary, distributed collaborative environment

### ● Technologies:

- **NIST Expresso** is the “model integration and view synthesis” engine (integrating discipline-specific models into the Product Master Model and synthesizing discipline-specific models out of the Product Master Model)
- **EXPRESS-X** mappings define the transformations between the **STEP AP** data (application-specific models created by tools) and the STEP-based **Product Master Model**
- **OMG PDM Enablers** interfaces will provide plug-and-play access for tools and applications via Web and ORB interfaces



# The NASA STEP Testbed Implementation Plan

- Identify NASA requirements for Intelligent-PDM (IPDM) and Integrated Model-based Systems Engineering (IMSE)
  - Document Use-Cases (Scenarios)
  - Identify all tools and services to be integrated and supported
  - Prototype an initial NASA Tool Interface Backplane Specification (based upon the OMG PDM Enablers, with extensions as reqd.)
  - Prototype the Product Master Model and mappings to discipline CAX models (as represented in STEP)
- Begin implementation of an IPDM / IMSE Pilot
  - Work has begun on pilot capabilities
  - Will collaborate with all interested NASA centers
  - Will seek to collaborate with ESA and PDES, Inc. aerospace partners



# The NASA STEP Testbed

## IPDM / IMSE Development Plans for FY00

- Initial PDM Enablers (PDME) interfaces (CORBA/IIOP access)
- Check-in/out of models via PDME and via file upload thru browser
- LDAP integration with NASA enterprise “portal” services:
  - X.500 personnel directory, user roles, project directory
  - Security services
- Prototyping of MCAD <-> ECAD model integration and sharing
  - The NASA STEP Testbed is collaborating with Boeing, IBM, and Delco-Delphi in the PDES, Inc. Electromechanical Pilot\*
- Standardization of a NASA Systems Engineering Information Model
  - Harmonization of Mission Design Parameters among NASA’s Integrated Design Centers
  - Implementation of a Systems Engineering integration client
- Participation by other NASA Centers is encouraged!

\* The PDES, Inc. Electromechanical Pilot Project is implementing MCAD/ECAD model exchange using STEP AP 203 and AP 210.

